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(54) Towed cable fairing

(57) A fairing for a towed submarine cable 13 comprises a plurality of wedge-shaped fairing elements 61 provided with means for attachment to the cable such that in use with the cable straight the blunt end of the wedge is at a uniform stand-off distance from the cable. Links 66 are inserted between pairs of adjacent fairing elements such that in use the fairing elements are located together in abutting relationship and on bending the cable the locating points can separate such that the fairing elements substantially maintain their positions relative to the cable. The blunt end 62 of the wedge is radiused so as to conform with the outer surface of the cable and two protrusions 63 are provided thereon so as to maintain the wedge in spaced relationship with the cable. The cable attachment clips are provided at the positions of the protrusions. Each link is provided with a pair of slotted tracks 69 and each fairing element has a pin 610 at a respective end for engagement in one of the slots. The link has a ringed portion 68 for engagement on the cable.

Fig.6.

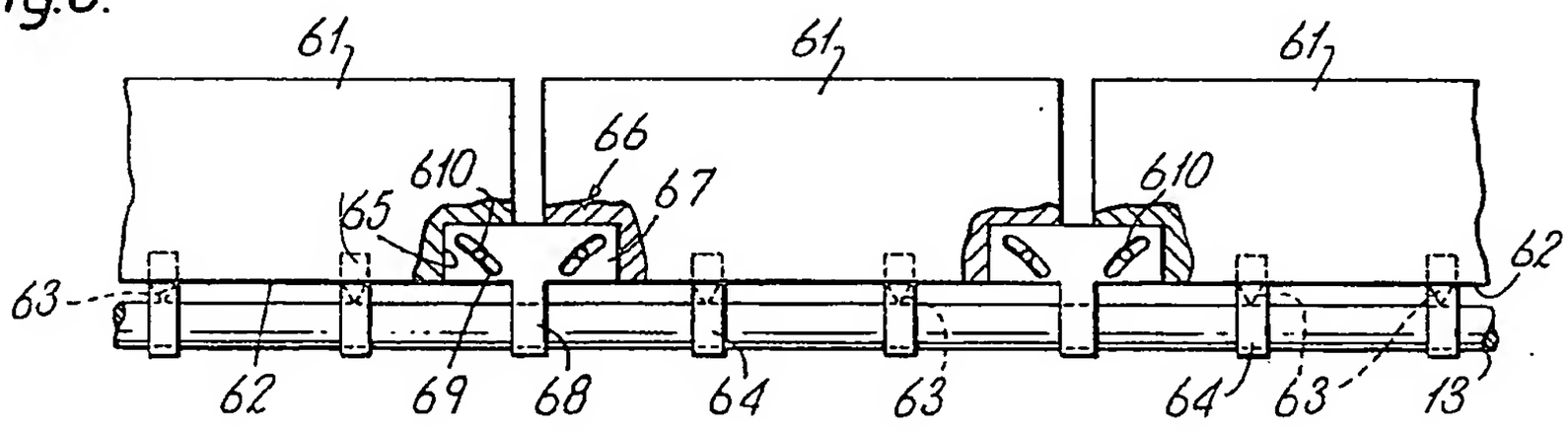

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Fig.1.

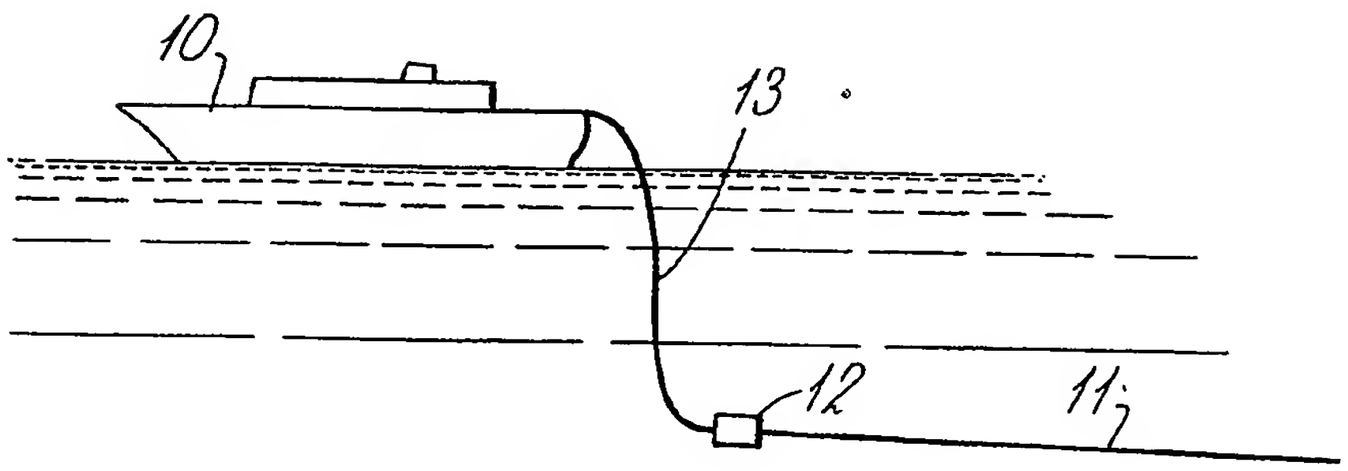


Fig.5.

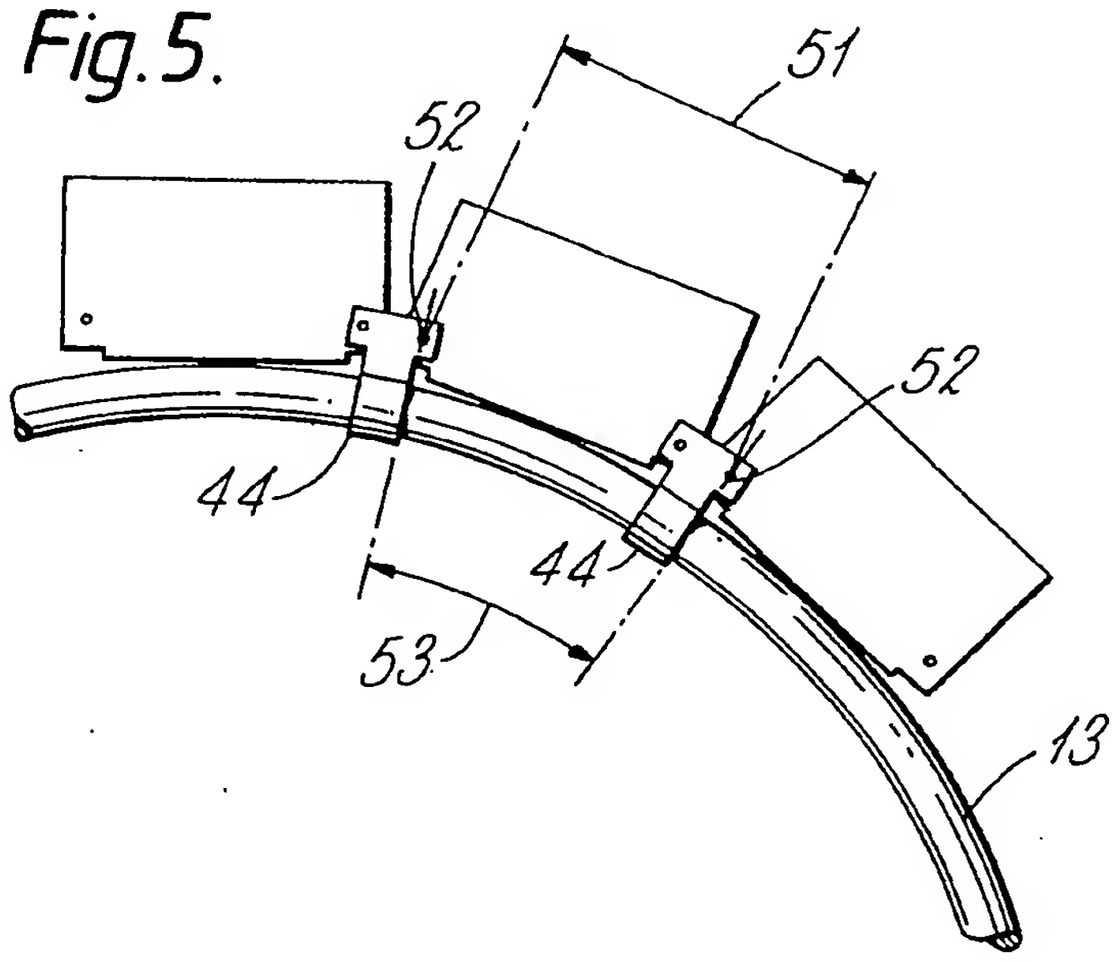


Fig.2a.

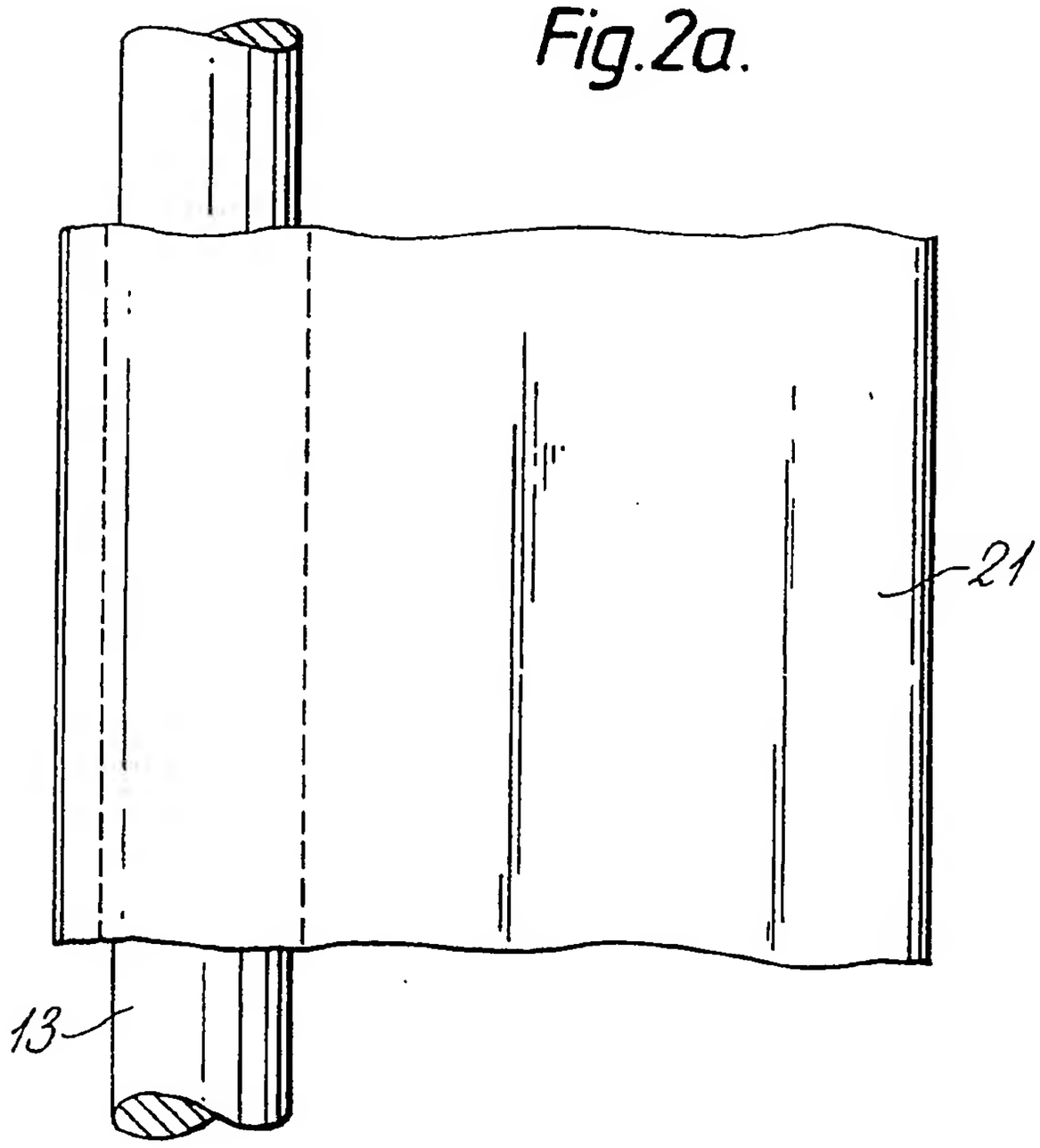


Fig.2b.

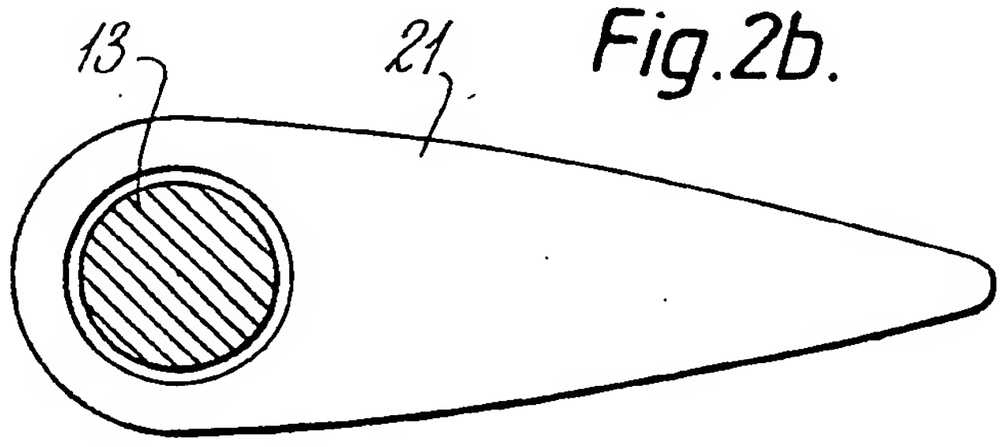


Fig.3a.

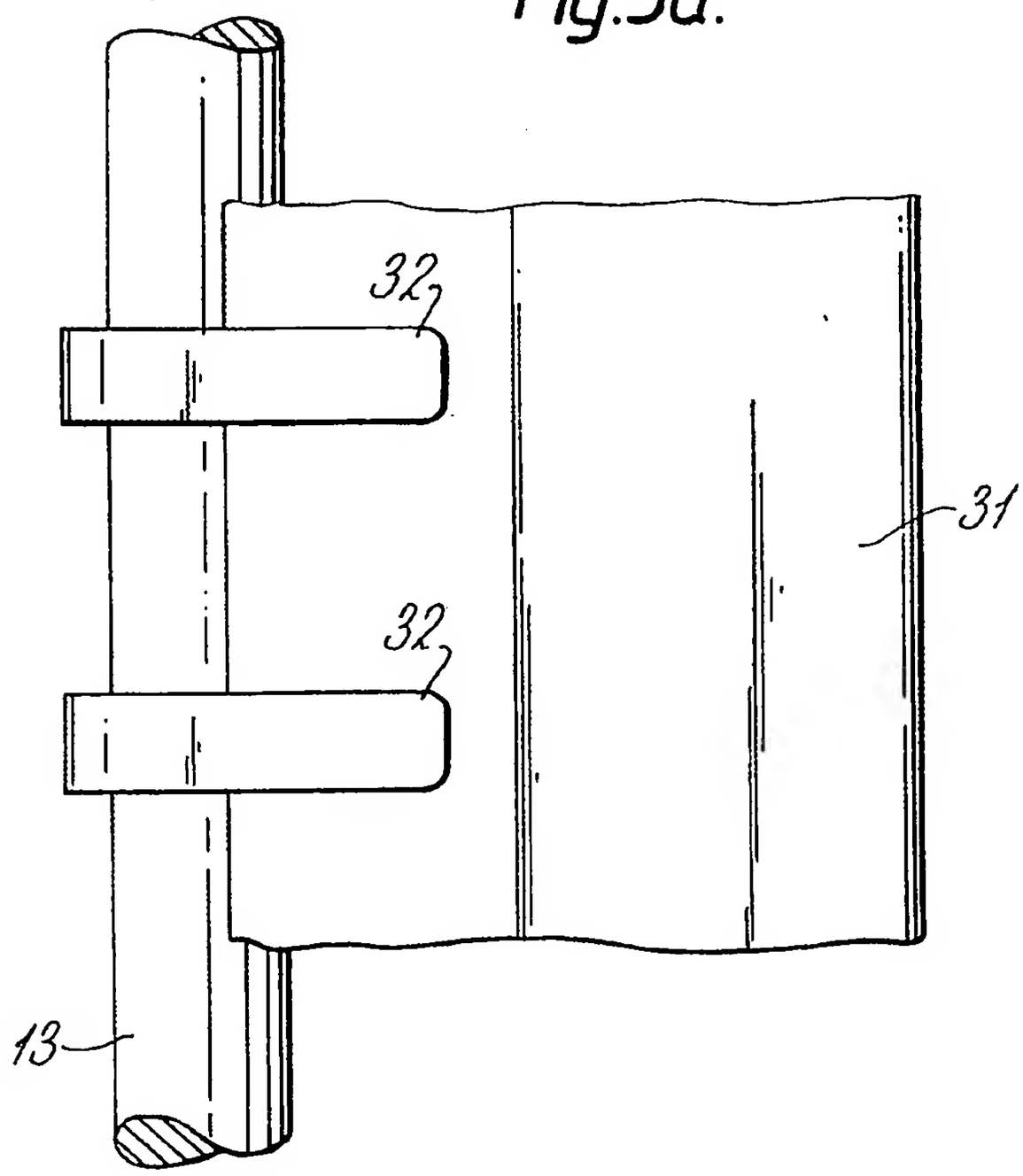
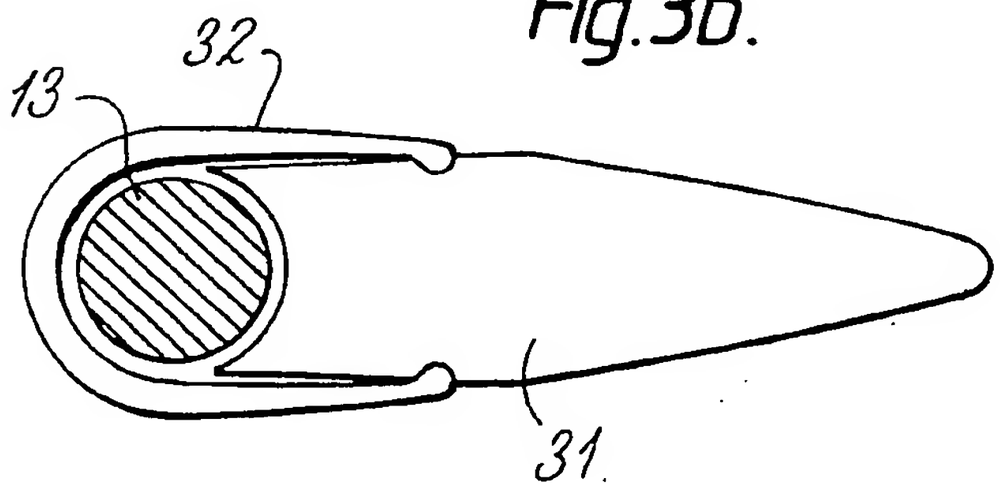


Fig.3b.



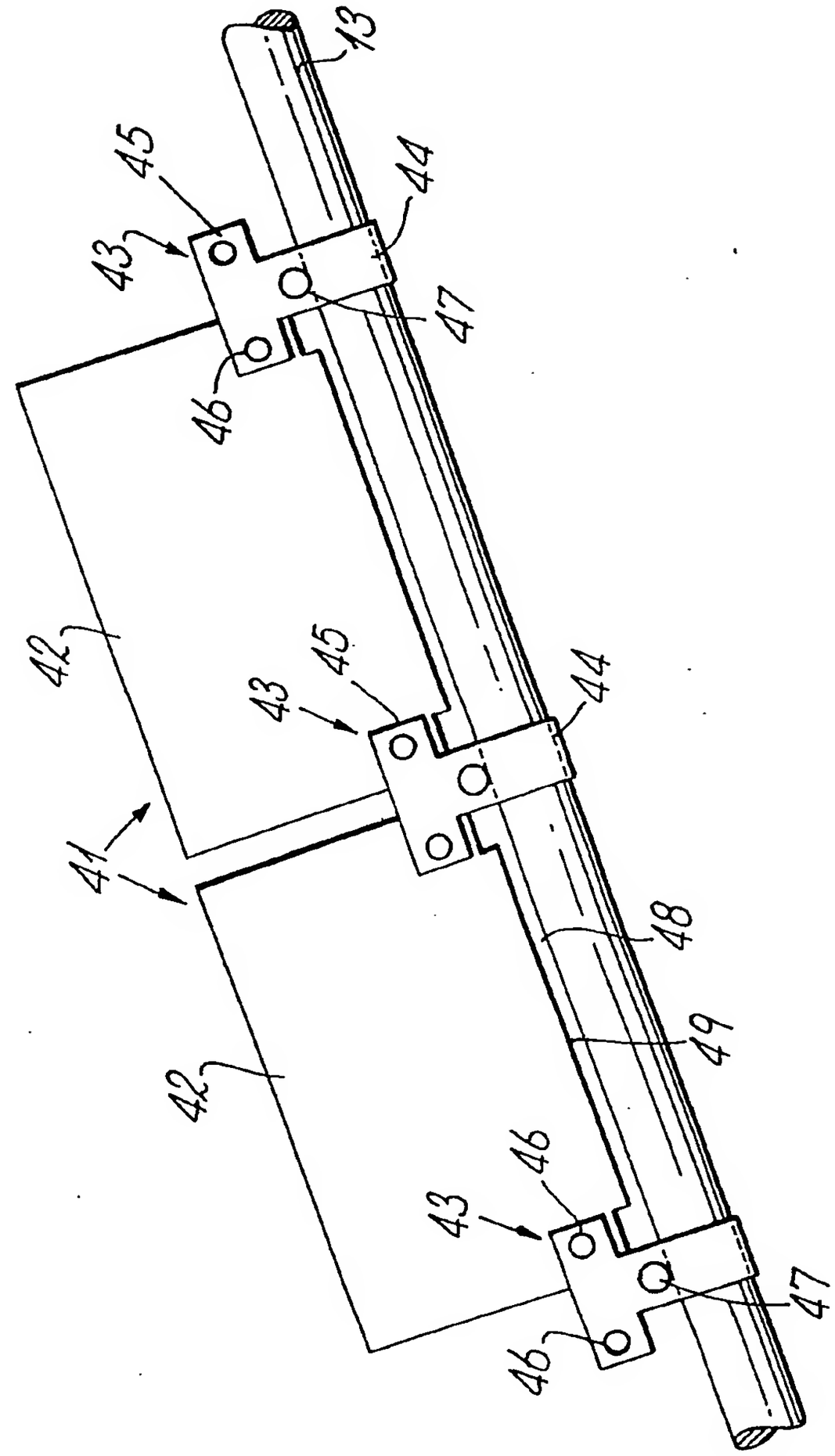


Fig.4.

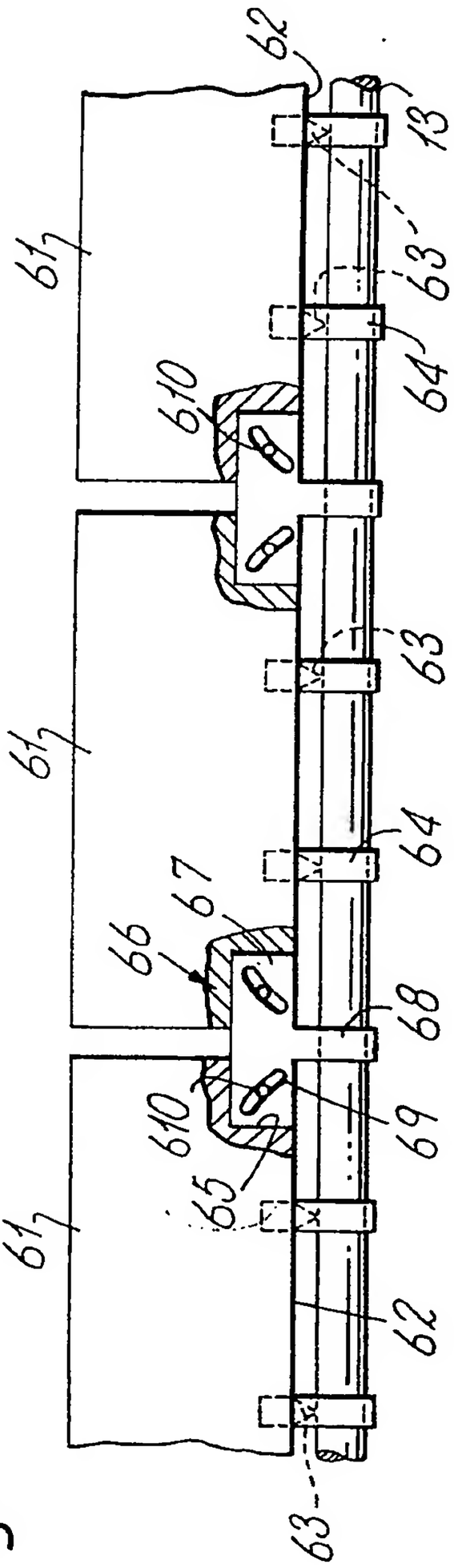


Fig.6.

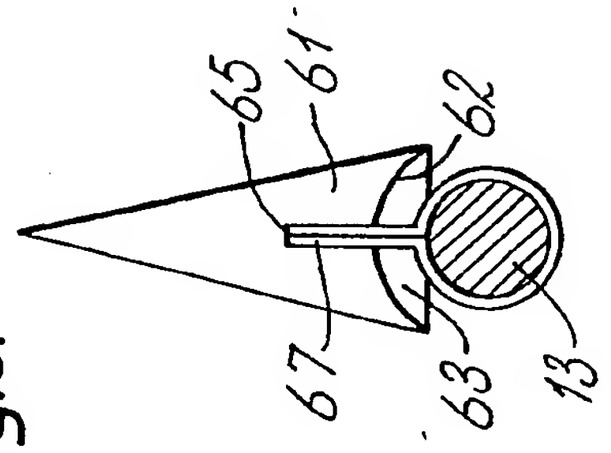


Fig.8.

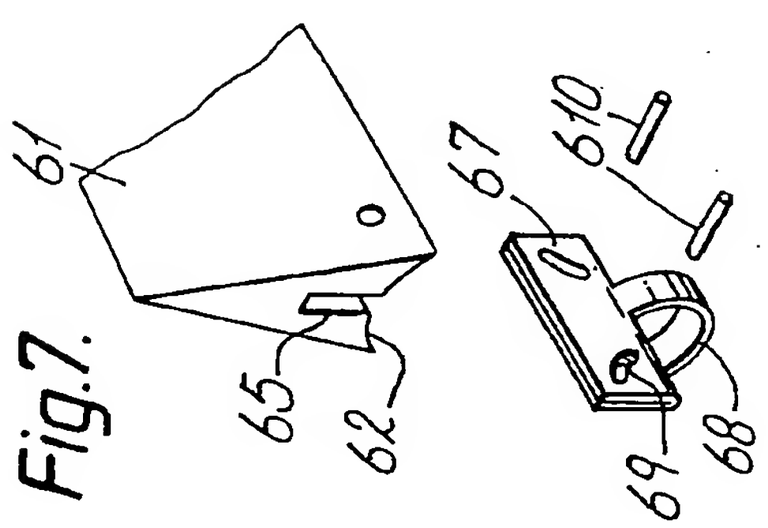


Fig.7.

SPECIFICATION

A towed cable fairing

The invention relates to underwater towed cables as used to tow sonar or other detectors where it is desirable for the detectors to be at a controlled distance below the towing vessel.

A towed device for underwater use may be attatched to a towing vessel by means of a strain cable. A weighted body or other means may be used on the cable to ensure that the shortest practical length of cable is needed to attain the required depth for the device beneath the vessel. The towing force on a length of cable between an underwater towed device and the towing vessel has a substantial horizontal component. This horizontal force can cause lateral movement of the cable which will be in the form of "lag" behind the towing vessel.

Cross currents can also create a horizontal force which will cause sideways movement relative to the towing vessel ("kiting").

The resultant effect of "lag" and "kiting" is that a greater length of cable will need to be deployed to maintain the required depth of the device. In addition to these effects vortex shedding in the region behind the cable produces tranverse forces which can cause vibration in the cable ("strumming"). In order to reduce the effects of the above forces fairings have been attached along the length of the cable. Such fairings are of three gereral types:

a) They may be in the form of ribbon streamers;

b) They may completely surround the cable; or

c) They may be generally wedge-shaped and free to rotate and thus become oriented on the downstream side of the cable. In the latter case the fairing elements are attached to the cable by clips. In cases b) and c) the fairings are generally articulated by providing a string of juxtaposed fairing elements connected to each other in such a way as to allow the cable to bend and in particular to allow the cable to be reeled in and out. A string of fairing elements is then fixed to the cable by means of a top or bottom stop.

As the cable bends a wedge-shaped gap occurs between adjacent fairing elements. The size of the gap is a function of the radius of curvature of the cable. The bending of the cable also creates relative endwise movement of the fairing elements because of the differing path lengths between a line drawn through the fairing element connection points and the length of the adjacent cable. The endwise movement of the fairing is accumulative and as a faired cable is passed over a pulley or wound onto a drum the fairing "walks" in the direction of travel of the cable movement. This leads to handling problems during reeling and has caused damage to clips, fairing elements and cable. The "walk" phenomenon can also occur during towing since the cable tends to form a curve due to the flow forces. Movement of the fairing has been accomodated by the use of a plurality of strings of fairing elements on the cable with suitable gaps provided between adjacent strings and with each string being attached to the cable by a top stop for example. This, however, significantly reduces the hydrodynamic efficiency of the fairing. Use of a bottom stop can lead to "saw tooth" bunching of the string due to the vertical component of the towing force.

The object of the invention is to provide an improved cable fairing, overcoming some of the disadvantages of the prior art arrangements.

The invention provides a towed cable fairing comprising:

a plurality of generally rectangular fairing elements each generally wedge-shaped in profile;

means for attachment of the fairing elements to the cable such that in use with the cable straight the blunt end of the wedge is at a uniform stand-off distance from the cable; and

means inserted between pairs of adjacent fairing elements such that the fairing elements in use are located together in abutting relationship;

the locating means being arranged such that on bending the cable the locating points can separate such that the fairing elements substantially maintain their position relative to the cable. Advantageously the blunt end of the wedge is radiused so as to conform with the outer surface of the cable and two protrusions are provided thereon so as to maintain the wedge in spaced relationship with the cable. Preferably cable attachment clips are provided at the positions of the protrusions.

In the preferred arrangement the locating means is a link provided with a pair of slotted tracks and each fairing element has a roller at a respective one end for engagement in one of the slots. The link is preferably provided with a ringed portion for engagement on the cable. In one form, to facilitate manufacture, the slots are linear, being closer together on the cable side of the link. In the preferred form, however, the slots are double curved so as to locate with increasing or decreasing radial position. In an advantageous form each link and the attached fairing elements are provided with tongues and complementary grooves such that on pivoting substantially no gap forms between the adjacent fairing elements. Advantageously the link comprises two identical slotted portions connected and held together by a resilient member so formed that the link can be opened for attatchment to the cable with the resilient member in contact with the cable. Preferably the link and resilient member are integrally formed of a plastics

material.

The invention will now be described with reference to the attached Drawings of which:

Figure 1 illustrates a ship towing a sonar device;

Figures 2a and 2b illustrate one form of known enclosed fairing for the towing cable;

Figures 3a and 3b illustrate a trailing fairing for the cable;

Figure 4 shows a cable with an articulated trailing fairing;

Figure 5 shows a cable as in Fig. 4 with a bend as when passing over a cable guide;

Figure 6 shows a cable fairing according to the invention;

Figure 7 is an exploded scrap view of a fairing link together with a fairing element; and

Figure 8 shows an end view of the cable fairing.

Fig. 1 illustrates a ship 10 towing a sonar device 11. The sonar device is connected at one end to a negatively buoyant body 12 which in turn is connected to a ship's winch by means of a cable 13. As the ship 10 tows the device 11 there are significant forces on the cable 13 sufficient to cause lateral movement of the cable away from a straight towing line and strumming of the cable due to vortex shedding.

Fig. 2 shows one solution to controlling the forces on the cable 13. An enclosed resilient fairing 21 is provided around the cable 13. On bending of the cable 13 there will be movement of the cable within the fairing 21 but the degree of bending possible is not satisfactory for reeling in and reeling out of the faired cable.

Fig. 3 shows an alternative solution using a trailing fairing 31, generally wedge-shaped in cross section. The fairing is attached to the cable by clips 32. This solution has a smaller profile than the Fig. 2 arrangement but suffers from the same inability to bend sufficiently in the plane of the Drawing.

Fig. 4 shows an articulated trailing fairing 41 comprising a string of trailing fairing elements 42 connected together by means of links 43. Each link 43 has an annular attachment portion 44 encircling the cable 13 and a plate 45 coplanar with the cable fairing elements 42. Pins 46 located at the ends of the plate 45 provide pivotal connection points for the adjacent fairing elements 42. A brass roller 47 is provided on the link 43 making contact with the upper surface of the cable to ensure that a constant distance 48 is maintained between the cable and the blunt end 49 of the fairing elements when the cable 13 is straight as shown.

Fig. 5 illustrates the movement of the cable 13 which takes place relative to the fairing attachment rings 44 on bending of the cable 13. The separation 51 between the front pivot pins 52 of adjacent fairing elements remains substantially the same while the arcuate length of the cable 53 between adjacent attachment rings 44 becomes much smaller.

To prevent damage to attachment rings, fairings and cable it has been necessary to provide a plurality of strings of fairing elements on a single cable. The fairing elements of each string are connected as shown in Fig. 5 and the strings are separated by gaps to allow "walking" of the fairing along the cable. The fairing "walk' is a particular problem when winding the faired cable onto a drum, however, it also occurs during towing because the cable tends to assume a curved shape in the water.

Figs. 6 to 8 show a trailing fairing according to the invention. The fairing elements 61 are substantially the same as those in Figs. 4 and 5. The fairing elements 61 are generally rectangular and wedge-shaped in cross section and are arranged in abutting relationship along the cable. The lower edge 62 is curved so as to conform with the outer surface shape of the cable 13. Two wedge-shaped protrusions or "pips" 63 are provided to maintain the fairing elements 61 at a uniform stand-off distance from the cable 13. Cable straps 64 are provided connected to the fairing elements 61 at the locations of the pips 63 for attachment to the cable 13. A slot 65 is provided in each end of the fairing element 61 for entry of a link 66 interconnecting adjacent fairing elements. The link 66 is made from a resilient plastics material and comprises two identical plates 67 resiliently held together by a ring portion 68 which encircles the cable 13. The link 66 can thus be readily attatched and removed from the cable. Curved slots 69 are provided one at each end of the link 66. The slots 69 are slidingly engaged by pins 610 attached to respective ends of the adjacent fairing elements 61. The shape of the slots is such as to follow the locus of the pins 610 on bending of the cable assuming that the fairing elements maintain fixed positions relative to the cable.

In practice when the slots are to be cut from the links a best fit straight line slot can be substituted and this has been found to cause only a small amount of endwise movement on bending. The links can be shaped so as to be a tongue and groove fit with the adjacent fairing elements such that the link substantially fills the gap created between fairing elements on bending of the cable. By this means the hydrodynamic efficiency of the fairing can be improved. It is also possible that an articulated cable fairing according to the present invention could be provided with links and straps which are readily attached and detatched from the cable so that the fairing can be attached to the cable as it is payed out from its drum on the ship and on reeling in the fairing can be stripped off. Other modifications of the cable fairing will be apparent to those skilled in the art all falling within the

scope of the invention described herein.

CLAIMS

1. A towed cable fairing comprising:
a plurality of generally rectangular fairing elements each generally wedge-shaped in profile; means for attachment of the fairing elements to the cable such that in use with the cable straight the blunt end of the wedge is at a uniform stand-off distance from the cable; and means placed between pairs of adjacent fairing elements such that the fairing elements in use are located together in abutting relationship;
the locating means being arranged such that on bending the cable the locating points can separate such that the fairing elements substantially maintain their positions relative to the cable.

2. A towed cable fairing as claimed in claim 1 wherein the blunt end of the wedge is radiused so as to conform with the other surface of the cable and two protrusions are provided thereon so as to maintain the wedge in spaced relationship with the cable.

3. A towed cable fairing as claimed in claim 2 wherein cable attachment clips are provided at the positions of the protrusions.

4. A towed cable fairing as claimed in any one of claims 1 to 3 wherein the locating means is a link provided with a pair of slotted tracks and each fairing element has a pin or roller at a respective one end for engagement in one of the slots.

5. A towed cable fairing as claimed in claim 4 wherein the locating link is provided with a ringed portion for engagement on the cable.

6. A towed cable fairing as claimed in claim 4 or 5 wherein the slots in the locating link are linear, being closer together on the cable side of the link.

7. A towed cable fairing as claimed in claim 4 or 5 wherein the slots in the locating link are curved so as to diverge more rapidly with increasing radial position.

8. A towed cable fairing as claimed in any one of claims 4 to 7 wherein each link and the attached fairing elements are provided with tongues and complementary grooves such that on pivoting substantially no gap forms between the adjacent fairing elements.

9. A towed cable fairing as claimed in any on of claims 4 to 8 wherein the link comprises two identical slotted portions connected and held together by a resilient member so formed that the link can be opened for attachment to the cable with the resilient member in contact with the cable.

10. A towed cable fairing as claimed in claim 9 wherein the link and resilient member are integrally formed of a plastics material.

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